



DEPARTMENT OF THE NAVY

COMMANDING OFFICER
NAVAL AIR STATION
700 AVENGER AVENUE
LEMOORE, CALIFORNIA 93248-5001

NASLEMINST 5104.1 CH-2

014

10 DEC 1996

NAS LEMOORE INSTRUCTION 5104.1 CHANGE TRANSMITTAL 2

From: Commanding Officer, Naval Air Station, Lemoore

Subj: INDUSTRIAL X-RAY RADIATION SAFETY PROGRAM (RSP)

1. Purpose. To transmit changes to basic instruction.

2. Action

a. Section II, page II-1, paragraph 1a(1), delete entire sentence and replace with, "NDI Technician Course (C-603-3191)."

b. Section II, page II-1, paragraph 1a(2), delete entire sentence and replace with, "Radiographic Operator Course (A-701-0032)."

c. Section IV, page IV-3, paragraph 1e, add the following sentence at the beginning of paragraph (e), "All x-ray machines shall be warmed up in accordance with the manufactures technical manual for the type/model x-ray apparatus used. "

d. Section IV, page IV-3, paragraph (g), last line, after the word "log", add the following sentence, "At the completion of the shift or final x-ray radiography operation of the day, final and net readings of the pocket dosimeters shall be recorded in the pocket dosimeter log."


L. D. CHILDRESS

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30 MAY 1996

NAS LEMOORE INSTRUCTION 5104.1 CHANGE TRANSMITTAL 1

From: Commanding Officer, Naval Air Station, Lemoore

Subj: INDUSTRIAL X-RAY RADIATION SAFETY PROGRAM (RSP)

1. Purpose. To issue pen and ink change to basic instruction.

2. Action. Make the following pen and ink changes:

a. Page 1, paragraph 4, second line delete "Medical and Dental".

b. Page 1, paragraph 5, second line change "aplicable" to "applicable and "Reference" to "reference".

c. Enclosure (1), page I-2, paragraph 4b, line 1, after supervisor, delete "or" and replace with "and".

d. Enclosure (1), page III-2, paragraph 2b(2), change to read "RSO/ARSO (Refer to Recall Roster)".

e. Enclosure (1), page III-2, paragraph 2b(3), change to read "AIMD Officer/Assistant AIMD Officer (Refer to Recall Roster)".

f. Enclosure (1), page III-2, paragraph 2b(4), change to read "AIMD NDI Lab Work Center Supervisor/Assistant (Refer to Recall Roster)".

g. Enclosure (1), page IV-2, Note: Line 6, after the word "shall" add "not".

h. Enclosure (1), page IV-3, paragraph 1d, delete line space.

i. Enclosure (1), page IV-3, paragraph 1i, last line, after the word "before" insert: "the results of the primary dosimetric evaluations are known if".

j. Enclosure (1), page IV-4, paragraph 1i(2), second line, add ")" after "reference (a)".

k. Enclosure (1), page IV-5, paragraph 1m, second line, add space in between the words "in between".

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l. Enclosure (1), page IV-5, paragraph 1p line 1, change "physically inspect the roof to ensure" to read "ensure the roof is physically inspected to verify".

m. Enclosure (1), page V-4, paragraph 1b(13)(b), second line, add ")" after (a).

n. Enclosure (1), page V-6, paragraph 1b(23), line one, change "radiography" to read "radiographer".

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NAS LEMOORE INSTRUCTION 5104.1

From: Commanding Officer, Naval Air Station, Lemoore

Subj: INDUSTRIAL X-RAY RADIATION SAFETY PROGRAM (RSP)

Ref: (a) NAVSEA S0420-AA-RD-010 (RAD-010)

Encl: (1) Supplemental RSP Program Guidance

1. **Purpose**. To implement the Industrial X-Ray Radiation Safety Program established by reference (a).

2. **Background**. Industrial x-ray radiation represents a potential for serious radiation exposure to Navy personnel (military and civilian) involved in industrial x-ray operations. The Navy has adopted the philosophy of maintaining individual and collective exposures to ionizing radiation "As Low As Reasonably Achievable" (ALARA). The established maximum administrative control levels of radiation exposure is 0.5 REM per calendar year. To exceed this level requires written approval from the Commanding Officer. The establishment of a comprehensive x-ray Radiation Safety Program is essential to ensure protection for all Navy personnel who have the potential for exposure to x-ray radiation.

3. **Policy**. It is command policy to protect the safety and health of personnel from exposure to x-ray radiation. This shall be accomplished through an aggressive and comprehensive x-ray Radiation Protection Program (RPP) implemented through the chain of command without reducing required operational readiness conditions or training requirements.

4. **Applicability**. The provisions of this instruction apply to all Navy civilian and military personnel, Medical and Dental who have the potential for exposure to industrial x-ray radiation in the performance of their official duties. Medical and dental x-ray operations are excluded.

5. **Action**. All Navy civilian and military personnel (as applicable) shall become familiar with the contents of Reference (a) and support the X-Ray Radiation Protection Program through full compliance with the applicable policies, procedures, actions and guidance set forth therein. Supplemental guidance is provided by local implementing procedures contained in enclosure (1).

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SECTION I
RESPONSIBILITIES

1. Commanding Officer:

a. Ensure a Radiation Safety Program is established in writing and fully implemented.

b. Designate in writing a qualified Radiation Safety Officer (RSO) and an Assistant Radiation Safety Officer (ARSO).

c. Grant authority to the RSO to immediately halt any radiation operations considered unsafe and provide the RSO direct access to the Commanding Officer on all matters dealing with radiation safety.

2. Radiation Safety Officer:

a. Establish, implement and maintain an effective Radiation Safety Program that complies with the provisions of reference (a) and other applicable Navy directives and Federal regulations.

b. Provide advice and assistance to all elements of the command on all matters pertaining to x-ray radiation safety requirements, procedures and command policy.

c. Establish and maintain liaison with the Radiation Health Officer to coordinate the x-ray radiation safety program and the radiation health program.

3. X-Ray Radiation Supervisors:

a. Ensure operations are conducted in compliance with this instruction and other applicable Navy directives and Federal regulations.

b. Ensure employees under their supervision have received required training as detailed in Section II of this instruction prior to being occupationally exposed to x-ray radiation.

c. Provide an immediate report to the RSO any violation of this instruction or other applicable directive; or any incident, personnel injury, suspected overexposure or any questionable occurrence involving x-ray operations.

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4. Radiation Workers:

a. Ensure full compliance with all posted, verbal and written x-ray radiation safety instructions.

b. Promptly report to their supervisor or the RSO any incident, personal injury, suspected overexposure or questionable occurrence involving x-ray radiation operations.

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SECTION II
X-RAY RADIATION TRAINING

1. Formal Radiation Safety Training Requirements for X-Ray Radiographers:

a. Initial Training. Each x-ray radiographer shall successfully complete one of the following courses which shall be documented:

(1) NDI Technician Course (C-603-3191) presented by Naval Unit, Chanute Air Force Base, Rantoul, Illinois.

(2) Radiographic Operator Course (A-701-0032) presented by Service Schools Command, San Diego, California.

(3) A local command sponsored course which has written approval of the radiation safety content from NAVSEADET RASO.

(4) A commercial company course for which the curriculum has been reviewed for radiation safety content and approved by NAVSEADET RASO.

b. Periodic Training

(1) Each x-ray radiographer shall complete at least six hours of annual refresher training which includes, as a minimum, the following subjects. Successful completion of this training shall be demonstrated by attaining a score of 70 percent or higher on a written examination.

(a) Command x-ray radiography operating and emergency procedures.

(b) RADIAC survey equipment requirements and operation.

(c) Personnel dosimetry requirements.

(d) Responsibilities of radiography and radiation safety key personnel.

(e) Maintenance of required records.

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(f) Relative risk associated with exposure to ionizing radiation.

(g) X-ray radiography accident case histories.

(h) Local procedures for maintaining personnel exposure As Low As Reasonably Achievable (ALARA).

(i) Requirements of Section IV (x-ray radiography) of reference (a).

(2) In addition to annual refresher training on the above subjects, training shall be conducted and documented each time there is a substantive change in equipment or operating procedures.

c. Periodic training shall be conducted by the RSO or his designated representative or both and shall be documented.

2. Radiation Safety Qualification Training for X-Ray Radiography Radiation Barrier Monitors:

a. Initial Training. Prior to assignment as barrier monitors, personnel shall receive initial training in the following areas. Successful completion of this training shall be demonstrated by the student attaining a score of 70 percent or higher on a written examination. All training shall be documented.

(1) RADIAC survey instrument operation.

(2) Barrier survey techniques.

(3) Radiation exposure standards for radiation barriers.

(4) Requirement to keep personnel from crossing barriers into radiation areas, except during emergencies.

(5) Requirement for and methods of communications with the radiographer during operations.

(6) Principles and operation of personnel dosimeters.

(7) Relative risk associated with exposure to ionizing radiation.

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b. Periodic Training. Personnel designated as barrier monitors shall receive annual refresher training on the topics listed above. The duration of the training shall be determined by the command RSO. This training shall be conducted by the RSO or a designated representative and shall be documented.

3. Radiation Safety Training Requirements for Occupationally Exposed Females and their Supervisors:

a. Instruction concerning prenatal exposure to the unborn child shall be given to personnel who supervise female workers.

b. Training shall be provided to occupationally exposed females regarding the nature of the potential risk to the embryo or fetus from x-ray radiation exposure.

c. All female personnel receiving instruction per this paragraph shall sign the following statement prior to being issued dosimetry equipment:

"The recommendations of the National Council on Radiation Protection and Measurements to limit exposure to the unborn child to the very lowest practicable level, not to exceed 0.5 REM during the entire period of pregnancy, have been explained to me.

Signature_____

Type or Printed Name_____

Date_____

The signed statements shall be kept with the individual's service training records for military and official personnel folder for civilian indefinitely. Statements signed by visitors shall be retained for three years.

d. Any directives on exposure limits for the unborn child that are in addition to reference (a) and U.S. NRC Regulatory Guide 8.13 shall not be used unless prior approval is obtained from Naval Sea Systems Command (SEA-06GN). Because of the signed statement required above from personnel who receive this training, written examinations are unnecessary and inappropriate.

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e. The training shall be conducted by the RSO or a designated representative and shall be documented.

4. Radiation Safety Training Requirements for Emergency Personnel:

a. Initial Training. All "emergency personnel" who could be exposed to ionizing radiation during the performance of their emergency duties shall receive training on the following minimum topics:

(1) Sources of radiation in areas where they may be required to respond.

(2) Potential hazards associated with radiation sources in areas where they may be required to respond.

(3) Relative priority of radiological controls versus other safety considerations during an emergency.

(4) Procedures to avoid or reduce exposures in emergency response actions.

(5) Procedures to avoid or reduce potential radioactive contamination in emergency response situations.

(6) Personnel radiation safety requirements (i.e., protective clothing, stay times, dosimetry, etc.) for personnel entering radiation areas under emergency conditions.

(7) Familiarization with the physical layout of facilities.

(8) Persons to contact to provide radiological controls support during or after an emergency.

b. This initial training shall be of a minimum duration of two hours, shall be conducted by the RSO or a designated representative, and shall be documented.

c. Periodic Training. Persons classified as "emergency personnel" shall receive annual training covering the scope of the initial training requirement. Additional training shall be provided whenever there is a significant increase in radiation

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exposure potential due to additional or different sources of ionizing radiation. Periodic training shall be conducted by the RSO or a designated representative and shall be documented.

d. An exercise of the Radiation Emergency Response Plan shall be conducted at least annually under realistic conditions.

5. Radiation Safety Training Requirements for other Organizational Personnel:

a. Initial Training. Those personnel who routinely work in or frequent areas adjacent to radiation areas shall receive an initial briefing on the need to heed radiation warning signs and boundary markers.

b. These personnel shall be informed of the nature of potential radiation exposures and that the majority of their exposures come from natural background, man-made enhancements to background and medical exposures (with the latter comprising the most significant portion). The briefing should include an explanation of what is done to protect them from radiation exposure. All personnel should be encouraged to contact the RSO if they have additional questions regarding radiation exposure in their work areas.

c. Periodic Training. Because of the sensitive nature of the subject of potential radiation exposures, the RSO shall repeat the initial briefing as frequently as necessary to allay concerns.

6. Required Training Records. While the actual conduct of radiation safety training is vitally important to maintaining a sound radiation safety program and reducing personnel exposure to ALARA, it is also vital that this action be documented. Failure to document required training is considered to be evidence of failure to conduct required training and will be so noted in internal audits and compliance inspections. Radiation safety training records shall be maintained as follows:

(1) Initial Radiation Safety Training

(a) Records of initial radiation safety training for radiation workers are a permanent record and shall normally be retained in the individual's service record for military and official personnel folder for civilian employees.

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(b) For other categories of personnel, records of initial training shall be maintained in organizational training records for as long as the individual is assigned to the organization.

(c) Records of initial training shall be course completion certificates or signed memorandums stating successful completion of specified initial training and copies of exams and scores of personnel. Memorandums of completion shall be signed by the RSO or individual conducting the training.

(2) Periodic Radiation Safety Training

(a) Records of required periodic radiation safety training for all categories of personnel shall be maintained by the RSO or activity training office for a period of three years.

(b) Records of periodic training may be kept in any format. As a minimum, the record shall identify the date of training, subject matter covered, length of training, persons(s) conducting the training, and attendees.

SECTION III EMERGENCY PROCEDURES

1. In the event of any of the following emergencies the radiographer shall shut down the x-ray unit and immediately contact the command Radiation Safety Officer (RSO) or Assistant Radiation Safety Officer (ARSO) at the Safety Office (ext. 3931/3932).

a. Fire or other emergency in the building or vicinity of x-ray operations.

b. Malfunction of the equipment and/or safety devices.

c. Theft or loss of radiation material, equipment, or machines that produce ionizing radiation.

d. Standard operation procedure violations.

2. In the event of real or suspected personnel overexposure or unauthorized/accidental entry of personnel into a controlled area, the radiographer shall shut down the x-ray unit and immediately notify, by telephone, the Command Duty Officer (CDO) at ext. 3301. The CDO shall contact the following personnel:

a. During normal hours of operation:

(1) NAS Lemoore Naval Hospital Officer of the Day (OOD) at ext. 4481.

(a) Hospital OOD shall contact:

1 Emergency Room at ext. 4435

2 Radiation Health Safety Officer at ext. 4281.

(2) RSO/ARSO at ext. 3931/3932.

(3) Aircraft Intermediate Maintenance Department (AIMD) Officer at ext. 1671.

(4) Non Destructive Inspection (NDI) Work Center Supervisor at ext. 1691.

b. After normal hours of operation:

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(1) NAS Lemoore Naval Hospital OOD at ext. 4481.

(a) Hospital OOD shall contact:

(1) Emergency Room at ext. 4435.

(2) Radiation Health Safety Officer at ext. 4281.

(2) RSO/ARSO at ext. 3931/3932.

(3) AIMD Officer/Assistant AIMD Officer at ext.
1671/1669.

(4) AIMD NDI Lab Work Center Supervisor/Assistant at
ext. 1691.

**NOTE: NAMES OF PRIMARY AND ALTERNATE INDIVIDUALS AND THEIR
TELEPHONE NUMBERS TO BE CONTACTED AS INSTRUCTED ABOVE.**

3. Other emergency telephone numbers:

a. Security Dispatch - 9-911

b. Fire Department - 9-911

c. Safety Manager - 3931/3934

4. Methods of Terminating X-Ray Operations

a. Turn key on control box to the "Off" position.

b. Turn control panel switch to the "Off" position.

c. Press Large, Red "X-Ray Off" button.

d. Activate interlock safety devices.

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SECTION IV OPERATING PROCEDURES FOR SHIELDED FACILITY

1. The shielded facility located at Airframes, Building 188, Room 109, uses a Magnaflux x-ray unit with a maximum output of 150KVp and 7Ma. This facility shall conform with all of the following physical and operational requirements:

a. Physical Requirements

(1) The x-ray tube head and all objects to be irradiated are within a permanent structure, within which no person is permitted to remain during irradiation.

(2) Each entrance or panel providing access to the shielded facility must have fail-safe interlocks installed or must be locked from inside the facility to prevent access from outside the x-ray exposure facility.

(3) The exposure rate in any accessible unrestricted area at one foot from the outside surface of the facility shall not exceed 2mR in one hour. The exposure rate in any normally occupied area around the facility shall be such that a person would not exceed 100mR in seven consecutive days or 500mR in one year.

(4) The interior of the facility shall be posted with signs containing the conventional magenta or purple three-bladed radiation symbol and the words "Danger - High Radiation Area" on a yellow background. There must be sufficient signs to be visible by anyone entering the facility.

(5) All entrances to the facility shall be posted with a sign containing the conventional magenta or purple three-bladed radiation symbol and the words "Caution -Entering Radiation Exposure Room" on a yellow background.

(6) All entrances to the facility shall have a light outside which is illuminated simultaneously with x-ray production. This light may be an illuminated sign reading "X-Ray On" or a flashing light with a sign or label indicating "X-Ray On When Lit".

(7) Each of the six barriers "four bulkheads, deck and overhead" shall be clearly stenciled with their classification as

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a primary barrier or secondary barrier. Any barrier labeled as a secondary barrier shall also be stenciled with the words "Do Not Irradiate With Primary Beam".

b. Operating Requirements

(1) All x-ray operations shall be coordinated with the Command Radiation Safety Officer (RSO).

(2) A qualified x-ray radiographer shall operate the x-ray console. The Radiographer shall not unlock or enable the x-ray control panel until ready to energize the x-ray unit.

(3) Command approved operating and emergency procedures shall be available in the vicinity of the x-ray console.

(4) There shall be at least one RASP approved, calibrated, and operating radiation survey instrument located at the console panel at all times when x-ray radiography is being conducted.

NOTE: Radiation survey instruments to be used in the x-ray radiography operation shall be source checked for proper response to radiation, following the NAVSEASYS COM (SEA-04R) provided procedures, prior to the first use of the day or shift. Instruments that fail to respond within the acceptable response range shall be used until they have been returned to the calibration facility for re-calibration or repair. Satisfactory source checks shall be annotated in the utilization log.

c. The following logs, records and reports shall be maintained by x-ray radiography personnel:

(1) Utilization log.

(2) Pocket dosimeter log.

(3) Radiation survey instrument and pocket dosimeter calibration records.

(4) Initial facility evaluations or facility re-evaluations reports.

(5) Radiation protection surveys and inspection reports.

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(6) RASP inspection records.

(7) Training records.

d. Prior to first exposure of the day or shift, the x-ray tube head, cables and console shall be checked for obvious

defects. All interlocks and warning or emergency devices shall be checked for proper operation and results annotated on the utilization log.

e. During machine warm-up or the first exposure of the day, a quick scan radiation survey and visual check shall be made of the primary personnel or equipment access door(s) to ensure that door overlap and deck coamings are intact and radiation streaming is not evident.

f. All personnel participating in the x-ray radiography operations shall wear two IM-235 series self-indicating pocket dosimeters and an approved primary dosimeter (TLD) as specified in NAVMED P-5055. Pocket dosimeters shall be worn near the individuals approved TLD.

g. IM-235 series pocket dosimeters shall be charged then zeroed at the start of the shift when x-ray radiography is to be conducted. The initial readings shall be recorded in the pocket dosimeter log.

h. Pocket dosimeters found to be off-scale during or after x-ray radiography operations require immediate action to evaluate and minimize possible personnel exposure.

i. If only one pocket dosimeter goes off-scale, the individual shall immediately be removed from radiation work. The primary dosimetric device shall be immediately returned to the Naval Dosimetry Center for evaluation. The Dosimetry Center shall be contacted by telephone or naval message to ensure proper routing is achieved. The individual may be allowed to return to work before **ALL** of the following conditions are met:

(1) The RSO can clearly establish that the off-scale pocket dosimeter is defective (See paragraph 4.6.2.9 of reference (a)).

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AND

(2) The pocket dosimeter which was not off-scale is functioning properly (See paragraph 4.6.2.9 of reference (a) and reads less than 10mR.

AND

(3) The RSO has determined that the individual was not exposed beyond the permissible limits in NAVMED P-5055 or established administrative limits.

j. The following checks shall be performed on both dosimeters (NOTE: Facilities with a RADIAC Calibration Laboratory shall perform a response check using NAVSEASYSKOM (SEA-04R) procedures):

(1) Drift Check. Charge to zero, then observe after two hours. Within the context of this procedure, a defective pocket dosimeter is one that undergoes greater than one-fourth of full scale deflection (upward drift) within two hours.

(2) Response Check. If the pocket dosimeter passes the drift check then a response check shall be performed as followed:

(a) Ensure that the pocket dosimeter has a current calibration sticker attached (NOTE: Re-calibration is required every six months).

(b) Zero the pocket dosimeter to be checked.

(c) Tape the side of the sensitive end of the pocket dosimeter to a cesium-137 check source such as those used for the radiography survey meters.

(d) After two hours, read the pocket dosimeter.

(e) Any upscale reading indicates a positive response and the dosimeter is considered good.

(f) If no upscale reading is noted, the pocket dosimeter shall be considered defective.

k. If both pocket dosimeters go off-scale or if only one goes off-scale and the other indicates a radiation exposure of

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greater than 10mR, the individual shall not be permitted to return to radiation work until the results of the primary dosimetric device evaluation are known.

l. X-ray control panels shall be equipped with a key switch which shall prevent the production of x-rays when placed in the "off" position. The "On and Off" position of the key switch shall be clearly marked and the key shall be removable only when the switch is in the "Off" position.

m. Whenever an exposure is not actually in progress, including setup inbetween exposures, the x-ray radiographer shall remove the key from the console and maintain personal custody until the next exposure is made.

n. Whenever x-ray equipment is not actually in use, it shall be secured to prevent use by unauthorized personnel. As a minimum, the control panel switch key shall be removed.

o. Prior to initiating an x-ray exposure, the radiographer shall personally inspect the facility to ensure that no one remains inside.

p. Radiographer shall physically inspect the roof to ensure that no personnel are on it prior to x-ray exposure. The Radiographer shall also ensure that the warning sign is posted on the boiler room door to ensure no unauthorized personnel access the roof without first verifying with the Leading Petty officer (LPO) or Leading Chief Petty Officer (LCPO) of the status of x-ray operations.

q. Radiographer shall ensure the secondary roof access is locked and the key has not been checked out. The key shall be kept in Work Center 530's office key box. During x-ray operations the console operator shall maintain constant possession of the roof key until x-ray operations are complete.

r. Whenever the shielded facility is entered after an x-ray exposure, the first person entering the vault shall use the radiation survey instrument to ensure that x-ray production has ceased.

s. Any restrictions on x-ray machine settings (i.e., do not exceed 120KVp, 5Ma) or tube head orientation shall be durably and obviously posted at the x-ray console.

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t. In the event of an earthquake in the vicinity of NAS Lemoore, the RSO will determine if a radiation survey of the vault is necessary depending on the magnitude of the quake. If the RSO confirms a survey is required, a complete survey will be conducted on all the adjacent walls and roof areas to ensure the integrity of those areas. The RSO will determine if the vault can be used depending on the results of the survey.

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SECTION V
OPERATING PROCEDURES FOR OPEN FACILITY

1. Facilities which do not meet the more restrictive requirements for an exempt shielded or shielded facility, shall be considered an open facility and shall conformed to the following physical and operational requirements:

a. Physical Requirements

(1) The x-ray tube head and all objects to be irradiated must be within a conspicuously posted perimeter that limits the area in which the expose rate can exceed 100mR per hour. This shall be designated the high radiation area.

NOTE: HIGH RADIATION AREA BOUNDARIES SHALL BE CALCULATED ONLY. Verification survey shall not be performed.

(2) The high radiation area barrier shall be conspicuously posted with signs containing the conventional magenta or purple three-bladed radiation symbol and the words "Danger - High Radiation Area" on yellow background. These signs must be visible to anyone approaching the high radiation area from any accessible route.

(3) The perimeter of the high radiation area shall be a physical barrier established by an enclosure or by stanchions and yellow, yellow and magenta, rope as necessary.

(4) A second physical barrier shall be established at the point at which the exposure rate equals 2mR in any one hour. This barrier shall be conspicuously posted with signs containing the radiation symbol and the words "Caution - Radiation Area". This in effect moves the radiation area (normally defined as any area where a major portion of the body could receive a radiation dose in excess of 5MR in any one hour or 100mR in any five consecutive days) forward to coincide with the restricted area boundary. These signs shall be visible to any person approaching the radiation area barrier from any accessible direction.

(5) There shall be located next to the tube head a rotating or flashing red light and warning sign stating "X-Ray On When Lit". The warning light shall be interlocked to the x-ray console so that it is illuminated when x-rays are produced.

NOTE: The red warning light is not required when it might compromise flight operations or flight line safety.

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(6) There shall be at least one qualified x-ray radiographer and two radiation barrier monitors on station where radiography is conducted as open facility operations. Additional barrier monitors shall be assigned as required to maintain complete surveillance of the radiation area boundaries.

b. Operational Requirements

(1) Open facilities use a Magnaflux x-ray unit with a maximum output of 150kVp and 7mA.

(2) All x-ray operations shall be coordinated with the command RSO. The RSO shall ensure that notification of the x-ray radiography operation is made to activities and personnel who will be in the immediate proximity of the radiation area.

(3) A qualified radiographer shall operate the x-ray console. He shall not unlock or enable the x-ray console panel until ready to energize the x-ray unit.

(4) Command approved operating and emergency procedures shall be in the vicinity of the x-ray unit.

(5) There shall be at least three RASP approved, calibrated and operating radiation survey instruments. One shall be at the operator's console and the other two shall be used to verify the radiation area boundary (2mR per hour line only).

UNDER NO CIRCUMSTANCES SHALL THE HIGH RADIATION AREA BOUNDARY BE SURVEYED.

(6) Radiation survey instruments to be used in the x-ray radiography operation shall be source checked for proper response to radiation, following the NAVSEASYSOM (SEA-04R) provided procedures, prior to the first use of the day or shift. Instruments that fail to respond within the acceptable response range shall not be used until they have been returned to the calibration facility for re-calibration or repair. Satisfactory source checks shall be annotated in the utilization log.

(7) The following logs, records and reports shall be maintained by x-ray radiography personnel:

(a) Utilization log.

(b) Pocket dosimeter log.

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(c) Radiation survey instruments and pocket dosimeter calibration records.

(d) Initial facility evaluations or facility re-evaluations reports.

(e) Radiation protection surveys and inspection reports.

(f) RASP Inspection records.

(g) Training records.

(8) Prior to first exposure of the day or shift, the x-ray tube head, cables and console shall be checked for obvious defects. All warning or emergency devices shall be checked for proper operation and the results annotated in the utilization log.

(9) All personnel participating in the x-ray radiography operations shall wear two IM-235 series self-indicating pocket dosimeters and an approved primary dosimeter as specified in NAVMED P-5055.

(10) IM-235 series pocket dosimeters shall be charged at the start of the shift when x-ray radiography is to be conducted. The initial readings shall be recorded in the pocket dosimeter log.

(11) At the completion of the shift or final x-ray radiography operation of the day, final and net readings of the pocket dosimeters shall be recorded in the pocket dosimeter log.

(12) Pocket dosimeters found to be off-scale during or after x-ray radiography operations require immediate action to evaluate and minimize possible personnel exposure.

(13) If only one pocket dosimeter goes off-scale, the individual shall immediately be removed from radiation work. The primary dosimetric device shall be immediately returned to the Naval Dosimetry Center for evaluation. The Dosimetry Center shall be contacted by telephone or naval message to ensure proper routing is achieved. The individual may be allowed to return to work before the results of the primary dosimetric evaluation are known if **ALL** of the following conditions are met:

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(a) The RSO can clearly establish that the off-scale pocket dosimeter is defective (See paragraph 4.6.2.9 of reference (a)).

AND

(b) The pocket dosimeter which was not off-scale is functioning properly (See paragraph 4.6.2.9 of reference (a) and reads less than 10mR.

AND

(c) The RSO has determined that the individual was not exposed beyond the permissible limits in NAVMED P-5055 or established administrative limits.

(14) The following checks shall be performed on both dosimeters (NOTE: Facilities with a RADIAC Calibration Laboratory shall perform a response check using NAVSEASYSKOM (SEA-04R) procedures):

(a) Drift Check. Charge to zero, then observe after two hours. Within the context of this procedure, a defective pocket dosimeter is one that undergoes greater than one-fourth of full scale deflection (upward drift) within two hours.

(b) Response Check. If the pocket dosimeter passes the drift check then a response check shall be performed as follows:

(1) Ensure that the pocket dosimeter has a current calibration sticker attached (NOTE: Re-calibration is required every six months).

(2) Zero the pocket dosimeter to be checked.

(3) Tape the side of the sensitive end of the pocket dosimeter to a cesium-137 check source such as those used for the radiography survey meters.

(4) After two hours, read the pocket dosimeter.

(5) Any upscale reading indicates a positive response and the dosimeter is considered good.

(6) If no upscale reading is noted, the pocket dosimeter shall be considered defective.

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(15) If both pocket dosimeters go off-scale or if only one goes off-scale and the other indicates a radiation exposure of greater than 10mR, the individual shall not be permitted to return to radiation work until the results of the primary dosimetric device evaluation are known.

(16) X-ray control panels shall be equipped with a key switch which shall prevent the production of x-rays when placed in the "Off" position. The "On" and "Off" position of the key switch shall be clearly marked and the key shall be removable only when the switch is in the "Off" position.

(17) Whenever an exposure is not actually in progress, including setup in between exposures, the x-ray radiographer shall remove the key from the console and maintain personal custody until the next exposure is made.

(18) Whenever x-ray equipment is not actually in use, it shall be secured to prevent use by unauthorized personnel. As a minimum, the control panel switch key shall be removed.

(19) Prior to the first exposure and warm-up of the day or shift, the following shall be accomplished:

(a) High radiation area and radiation area boundaries shall be calculated and posted with the required signs.

(b) The console shall be located behind the lead shield and as far away from the tube head as possible. The x-ray radiographer shall remain behind the lead shield during the entire time the x-ray tube head is operating.

(c) Radiation barrier monitors shall be briefed on their responsibilities and issued necessary radiation survey instruments and appropriate communications equipment.

(d) Radiographer shall personally inspect entire radiation area boundary to ensure that no one remains inside the area prior to energizing the x-ray unit.

(20) When conducting x-ray exposures on large objects such as on aircraft or sonar domes, the x-ray radiographer, **PRIOR TO X-RAY PRODUCTION, SHALL PHYSICALLY CHECK THAT NO ONE REMAINS IN THE OBJECT TO BE EXPOSED.**

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(21) When the x-ray machine is energized and producing x-rays, designated personnel shall survey the radiation area boundary and adjust it as necessary to ensure that no reading above 2mR per hour is noted. If beam orientation or technique factors change between exposure, the radiation area boundary must be re-established and verified by surveys. **UNDER NO CIRCUMSTANCES SHALL THE HIGH RADIATION AREA BOUNDARY BE SURVEYED.**

(22) Whenever the tube head is approached after an exposure, the first person in shall carry a RASP approved, calibrated and operating, x-ray radiation survey instrument to ensure the tube head is not producing x-rays.

(23) The x-ray radiography shall maintain constant surveillance of the entire radiation area boundary either through direct observation or by POSITIVE COMMUNICATION with radiation barrier monitors who are in position to provide visual surveillance. The intent of this requirement is to enable the radiographer to immediately shut down x-ray production if a person penetrates the radiation area boundary.

(24) Immediately upon determining that the radiation area has been penetrated, the x-ray radiographer shall cease production of x-ray. He shall notify the command RSO immediately.